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THE INTERNATIONAL CONGRESS OF ARTS AND SCIENCE.

THE widespread interest in the International Congress of Arts and Science, to be held at the St. Louis World's Fair from the nineteenth to the twenty-fourth of September, may justify a word concerning the latest stages of its development. SCIENCE has carefully sketched its beginning and its growth. Full discussions characterized the uniqueness of its plans and purpose and the scientific aims which are so different from the usual congresses with their disconnected programs and their lack of unity. These papers showed that the congress was to be controlled by the single purpose to work towards the unity and inner relation of knowledge; and that its program was a complete whole whose parts were in closest relation. The whole range of sciences is embraced, while the entire field was divided into twenty-four departments and these into one hundred and thirty sections. The addresses to be prepared by invited speakers are to deal in all departments alike with the inner unity and with the fundamental conception and methods, and in all sections alike with the interrelations to the neighboring sections and with the leading problems of the day. The discussion of the whole plan was followed in SCIENCE by reports with regard to the actions of the organizing committee that, under the leadership of Professor Newcomb, the president of the congress, secured the cooperation of leading specialists abroad. And, when at the beginning of June the list of chairmen and official speakers was completed and

published, SCIENCE reprinted the imposing list of participants for those departments which stand nearest to the interests of the magazine.

Since the program with the names of the hundred and sixty departmental and sectional chairmen and the three hundred and twenty official speakers has been published, only a few changes and additions have occurred in that part of the preparations. To be sure, some of the foreign speakers were obliged to withdraw at this late hour, but in most cases the cable filled quickly the vacancies with well-known substitutes from the same countries. In two or three cases two sections have been fused into one in accordance with special wishes. The few positions of chairman which appeared still vacant in the printed program have since been filled; the chairmen are without exception Americans. Among the speakers about a third are foreigners, representing all countries important in scholarship. Even Japan fills four important places. Canadians and Mexicans are counted as Americans.

In two respects the official list has since been supplemented. Firstly, each section has now its special secretary; and the honorary list of the hundred and thirty secretaries will be published in the September edition of the program. Further, most of the sections have an additional array of shorter contributions. As the introduction of the program said from the start, every sectional meeting should offer not only the two official addresses which form a part of the interrelated plan, but also some shorter contributions and communications by well-known specialists on special problems dictated by their own interests without immediate relation to the unity of the program. The official address on the problems of the section forms the natural transition to such special papers exemplifying the work of to-day in the field of the section. The invitations for such shorter contributions have been sent out at the suggestions of the different chairmen, and the chairmen themselves had been chosen at the suggestion of a majority of workers in the special field. But in most sections there is still ample room for any interesting short communication to be offered and any one may enter into negotiations with the chairman of the section to which his paper would belong. In those sections in which the time will not be entirely filled by the short papers discussions will be in order.

An important problem has been the distribution of halls for the meetings. The temporal distribution of the proceedings had already been sketched in the appendix of the program, and it may be said here, by the way, that *everybody can get the program by sending his address to Mr. Howard J. Rogers, Director of Congresses, World's Fair, St. Louis.* This appendix indicated the effort to avoid, as far as possible, every conflict between sections of related interests. Every participant can attend on Tuesday the meetings of three departments and in the following four days the meetings of eight sections, of which each fills a forenoon from ten to one o'clock or an afternoon from three to six. In this way sixteen sections always meet at the same time, but hardly ever sections of the same larger department. On Wednesday, September 21, from ten to one there will be meetings for instance of the following sixteen sections: Metaphysics, history of Greece, history of common law, comparative language, Slavic literature, inorganic chemistry, astrometry, geophysics, meteorology, animal morphology, social structure, public health, otology, civil engineering, public finance and the family. There is hardly a serious conflict of interests. The philosopher, for instance, has on that morning merely his one section on metaphysics while he can attend on the same day in the after-

noon the section philosophy of religion, on Thursday morning the section logic, on Thursday afternoon the section methodology of science, on Friday morning the section ethics, on Friday afternoon the section esthetics, on Saturday morning the section of comparative psychology and on Saturday afternoon the section abnormal psychology. In the same way the chemist, for instance, has Wednesday morning inorganic chemistry, in the afternoon organic chemistry, Thursday morning physical chemistry, in the afternoon physiological chemistry, Friday morning technical chemistry and so on.

It has been thus necessary to secure sixteen halls for the congress, all on the World's Fair grounds. The accommodations of the gigantic fair are amply sufficient for this purpose. We have the festival hall with its seating capacity of four thousand and convention hall with one thousand seats, the congress hall, the hall in the Missouri state building and in the transportation building, each with nearly a thousand seats and a dozen more halls with seats for two to six hundred. The chief aim in the distribution was again to bring together all that is internally related. As far as possible all sections of the same department will meet in the same hall. The lawyers will find all their legal sections in the Missouri building, the medical men will have most of the medical section in the transportation building, the sociologists theirs in recital hall, the pedagogical section will be in the educational building and so on.

There is no doubt this use of all the large halls of the World's Fair will make it comfortable for the audiences even if twenty thousand flock together during the congress week, as of course the large majority would not attend meetings from Monday till Saturday evening without interruption. It may be expected that most guests will attend three or four sections only and will enjoy the fair in the intervals. Twenty thousand ought to be, indeed, the figures of attendance to make use of the seating capacity. Will these twenty thousand really come? If the situation were correctly understood over the land the figure would probably be still larger; five thousand men interested in law or politics or social sciences, five thousand men interested in medicine or natural sciences, five thousand men interested in education, in history or philology or philosophy or mathematics, five thousand men interested in religion, in art, in literature, and there remain still the thousands interested in technology and many other departments. The congress boards hope that these figures are not an excessive calculation.

Only one thing seems to stand in the way of such wide attendance: the unfortunate rumor that the congress does not wish such popular participation. It seems that the misunderstanding arose as though this congress were not intended for the general public, but merely for a narrow set of selected specialists. Nothing can distort more the real intentions. Again and again we receive requests that we send an invitation to that or that friend. The fact is, *every educated man or woman who can appreciate the proceedings, especially every collegiate or professional man, is heartily welcome without any invitation.* The congress does not even demand any fees. While, for instance, the congresses connected with the Paris exhibition asked for considerable admission fees, the International Congress of Arts and Science in St. Louis requires nothing at all but the signing of one's name on the list of participants. The misleading rumor started probably from the fact that the chairmen, secretaries and speakers received special invitations. That, to be sure, was demanded by the whole idea of this congress: that the leading actors had to be selected a long time beforehand as

their work has to form a connected whole, but that does not involve a selection of the public which is to profit from the offerings.

It is true the rumor may have been reenforced by the fact that a limited number of scholars received, indeed, a special invitation to attend in form of a circular, but there was not the slightest intention to indicate that those who did not receive it were less welcome in the audience. To invite all who might have an interest in the proceedings of one of the hundred and thirty sections would have meant to invite half a million persons; every school teacher, every lawyer, every physician, every engineer, every political man, every literary man, yes, every educated business man, would have relations to some of the sections. No committee would have had the right to pick out among that half million those who are especially welcome at the congress, and the fact is no one dared to undertake any such selection. The only thing which the committee believed to be its duty was to send a program and invitation to at least a few thousand from whom special interest could be expected, that is, to the members of the leading national scholarly societies. It is clear that this means not a personal selection; the greatest scholars of the country may by chance not belong to any of these national societies. And thus it has happened, indeed, that some have received such invitations while others of the same high standing did not receive them; a differentiation was not intended at all. The membership lists of some dozen societies were used merely as help in spreading our programs, and it was hoped that every one who received the program would circulate it in his circle and interest his friends in the participation. We should have liked better to send it to half a million, leaving out no student who feels himself interested in any one part of the feast.

Of course the misunderstanding is limited to some quarters; many other symptoms show that the attendance will, indeed, come up to the unusual opportunity. Especially welcome is the movement which seems under way in some western colleges which begin as early as the middle of September. It is planned there to give leave of absence to those instructors who want to attend the congress. The eastern universities, of course, begin late enough to make it possible anyhow for the whole teaching staff to attend the meetings. It is to be hoped that the schools too will adopt a liberal policy and give leave to every teacher who is anxious to go to St. Louis, as this chance to come in close contact with the leading scholars in every field and to take part in this organized effort to bring harmony into the scattered mass of human knowledge is certainly a liberal education for every high aiming teacher. This six-day autumn school promises, indeed, to offer more than all the summer schools of this country and abroad together. Such a combination of speakers was never before brought together—may the combination of listeners and participants show worthy of the unique occasion.

Hugo Münsterberg.
Harvard University.

The Endowment of Astronomical Research.

In order to attain as great an advance in astronomical research during the twentieth century as in the nineteenth, careful plans must be made for its endowment. The same skill in organization, combination of existing appliances, and methodical study of detail, which in recent years has revolutionized many commercial industries, should produce as great an advance in the physical sciences. Astronomy in particular, through the striking progress it has made during the last half century, and its appeal to the imagination, has received

more liberal aid than almost any other science. This has enabled astronomers to develop well-organized observatories, and to carry on large pieces of routine work. They are, therefore, especially fitted for undertaking researches on a scale that will constitute a real advance. It is the object of the present pamphlet to show how this work can be carried still further, how the quality of the work can be raised to a new plane, and how a large or small sum of money may be expended so as to obtain the best results.

There are seven methods by which astronomy can be aided, each of which may be considered in turn.

1. *Fellowships for Astronomical Students.*—A large sum of money would not be required for this purpose. Ten fellowships, each yielding annually $500, would probably be sufficient. They should be used for students especially interested in astronomy, proposing to make it their profession, and showing a capacity for original research. The successful candidates should be sent to universities where special courses in advanced astronomical work are given. It is not desirable that there should be too many such fellowships, since the number of permanent positions for astronomers is limited. This difficulty is partly remedied by No. 7, described below. A large part of the expenses therein contemplated will be for personal services, and as work of the highest grade will be demanded, it is only fair that suitable salaries should be paid. The future of astronomy will depend largely on giving a proper preparation to the men to whom the most important equipments will be intrusted.

2. *Astronomical Expeditions.*—Large sums of money have been wasted in sending out expeditions, in charge of incompetent persons, to observe total eclipses of the sun. If the weather is cloudy at the time of the eclipse no result is obtained; if clear, the newspapers at once announce that a great success has been attained, and results secured which may prove of vast scientific value. In many instances, nothing further is ever heard of such work. The real addition to our knowledge of solar physics during the last thirty years, from such expeditions, considering the money expended upon them, is discouragingly small when compared with what might have been obtained by a more judicious expenditure of the same amount of money at a fixed observatory, where some results of value would surely have been obtained. It is often said that a discovery of so great importance may be made that it would compensate for the entire outlay, but this applies with equal force to almost any other plan of work. The fact that a government or individual will often make the appropriation desired for a special expedition, and would not make it for other astronomical work, in no way lessens the responsibility of those who ask for such aid.

Undoubtedly, every eclipse should be photographed by at least one skilful observer, and especial pains should be taken to solve particular problems, as the existence of an intermercurial planet, sudden changes in the corona, etc. The best method for securing results of real value appears to be that adopted by the English astronomers. A permanent committee is appointed which attempts, year after year, to solve certain problems of great importance. The experience gained during each eclipse aids later expeditions. Government assistance is often obtained in sending warships. Even then, the expenses are likely to be very great, and clouds may cause entire failure. If, therefore, good photographs are obtained, neither time nor money should be spared in making a careful examination and discussion of them.

3. *New Observatories.*—A new observatory of large size should only be established

after careful consideration. The gift of a large telescope, to a university unprepared to receive it, is often worse than useless. Not only can no work of much value be done with it, without a large annual expenditure, but the existence of large telescopes which are idle discourages other donors who see that there is no return for the great outlay. For teaching purposes, a telescope of eight to twelve inches aperture and a three-inch transit instrument are large enough. The best work in observation can never be done except when the atmospheric conditions are excellent, and this would seldom occur near a university or large city. On the other hand, a fruitful field is open in the application of photography to a very large reflector, but the best possible location, preferably in the southern hemisphere, as in South Africa, should be chosen. Such an instrument would be of little value unless means were provided for keeping it at work, and for discussing and publishing the results obtained.

There is one class of astronomical institution, a computing bureau, which might be established to great advantage at a large university, where work of the kind proposed was already in successful operation. At one institution the work undertaken might be the measurement and reduction of photographic plates, and at another the computation of orbits of comets and asteroids. An astronomer particularly successful in photographing the stars might find on his plates the trail of an asteroid of great interest, like Eros. Such an observation would be of no value unless he measured its position and, after taking additional photographs, determined its orbit. This he would do to great disadvantage compared with those who devote their entire time to such work, and could easily procure additional assistants as required.

4. *Publication.*—The cost of publishing many important investigations is too great to be provided for by existing periodicals. Means ought to be supplied so that no really good work should fail to reach the public for this reason. Provision should also be made for lengthy memoirs, the cost of which is sometimes very great, since they include extensive tables or require elaborate illustration. The work of deceased astronomers, when of sufficient value, should also be promptly completed, reduced and published. Probably the Astronomisches Gesellschaft and the Royal Astronomical Society would expend money to great advantage in this way.

5. *Aid to Working Astronomers.*—There is no way in which a more prompt and effective return can be obtained for a moderate outlay than by grants to astronomers qualified to expend them. The replies to the Circular of 1903, described below, and also to the Bruce Circular of 1890, show this very clearly. The number of good applications from German astronomers is particularly large. The sum of $10,000 would permit from ten to twenty valuable researches to be undertaken at once. Many of the ablest astronomers in Europe, and in this country, are obliged to devote nearly all of their strength and energy to teaching. In many cases, their interest is so great that they would gladly give much of their own time to researches of the greatest importance if, by a grant of a few hundred dollars, they could obtain the needed instruments, or employ assistants or computers. A donor could thus obtain, at a trifling expense, the services of some of the most eminent astronomers in the world, in expending his gifts. Care should be taken to make the restrictions as light as possible. A man of genius, in many cases, can not work at all, except in his own way, and at his own time.

6. *Aid to Existing Observatories.*—Several of our large observatories have now

the appliances for a greatly increased amount of work. Large sums of money could be expended for salaries of additional assistants, for publications, buildings, instruments, etc. As the executive organization is already provided, the returns from additional gifts should be very great. Many of the most important advances to be expected in astronomy will be obtained from large pieces of routine investigation. Astronomers having learned the best methods of determining the position, motion, brightness, spectrum and other properties of a star, should be prepared to apply them to great numbers of similar objects. Generally, the person who devises a new method is not the one best qualified to superintend a large corps of assistants, and to carry out an extensive routine investigation which may occupy many years.

7. *International Cooperation.*—This is probably the most important problem of all, and that most likely to lead to a real advance in astronomical science. The best illustration of the work contemplated is the determination, under the direction of the Astronomisches Gesellschaft, of the positions of northern stars of the ninth magnitude and brighter. A committee of experts should hold lengthened meetings and discuss plans in detail. It might be best to publish a provisional plan and invite criticism before beginning work. The observations should then be divided among those best qualified to make them, leaving to each observer greater or less freedom in carrying out the work. Preliminary observations would probably show which was the best method, and it is difficult to see why, in routine work, all should not conform to that. In determining a single quantity, like the solar parallax, of course the greatest variety of methods possible should be used. The reductions, publications and discussion should be made by those best qualified, and not necessarily by the observers.

As an example of the method of procedure, we may suppose a committee appointed who would first consider in turn, and in detail, the present needs of each department of astronomy. The answers to the circular described on page 298, give the views of the leading astronomers of the world, on this question. For instance, in considering the measurement of double stars, they would correspond with all astronomers now engaged in such observations. They would decide whether an undue, or an insufficient, amount of time and energy was directed to this work. They would then attempt to induce observers to adopt the best methods of measurement, and would supply micrometers of the most approved form, when needed. Observers displaying especial skill might be furnished with recorders or assistants who would learn their methods. In discussing orbits of double stars, complaint is often made that certain stars are neglected while a needless number of observations is made of others. If the subject was being neglected, an appropriation might induce a competent observer to take it up. All these difficulties could be reduced or avoided by proper organization, or, when necessary, supervision. The one object would be to secure the greatest scientific return for the given expenditure, and to avoid the reproach of the astronomer of the future, who may say that present opportunities have been neglected.

While a large sum of money, the equivalent of that required to establish an observatory of the first class, would be needed to carry out this plan in full, it will be seen that a moderate amount would permit a portion of it to be tested. The immediate expenditure of $50,000 to $100,000 would show results that would amply justify a larger outlay. Very different ends would

be attained by the different methods. Thus, No. 1 is educational, and insures the efficiency of the astronomer of the future, No. 5 aids the individual man of genius, while No. 6 and especially No. 7 undertake to solve the great problems now before us, and to advance the science to a new and higher plane.

The organization required to carry out this plan must next be considered. It may be divided into two parts, the care of the principal, and the expenditure of the income. The first of these is easily provided for and, if the amount is large, may well be left to the donor. Permanency, a relatively high rate of interest, and certainty that the wishes of the donor will be fulfilled are the three essentials. The expenditure of the income is a more difficult matter. If intrusted to an international committee, frequent meetings can not be held, and correspondence is slow and unsatisfactory in many cases. Such a committee, however, would be able to discuss problems from the broadest standpoint, and would be the best judge, in international work, of what part each country should undertake. A local committee could meet frequently and secure the active interest of several persons, but it could not consist of experts who would have a good technical knowledge of the researches to be undertaken. A national committee would occupy an intermediate position, with some of the advantages, but unfortunately some of the disadvantages, of both. The experience of the writer is that all the work of such a national committee is likely to be left to one man, and even if well attended meetings are held, it often happens that the wishes of the most aggressive member, and not the combined opinions of all, are carried out.

On the whole, the following plan is recommended: The appointment of a local committee consisting of men interested in astronomy but not necessarily familiar with its technical details. Investigators in some department of science, and men of affairs qualified to judge of other men, and of the work done by them, should be selected. With the proper machinery to collect the views of experts, such men could easily carry on successfully the first six of the methods described above. As a parallel case, the board of trustees of a university can select the best man for a professor of Sanskrit, or with expert aid can organize a technical school, although as individuals their knowledge of either subject may be very slight. The duties of this committee would be, first, absolute fairness. They should spend the income so as to secure the greatest scientific return, and should be wholly independent of all personal considerations, and of all local conditions. Secondly, their work should be active, not passive; they should try to spend the income, not to preserve it. Whenever an unusually able memoir was prepared by an astronomer hitherto unknown, they should make a business of learning his needs, what he would require to carry his work still further, and if possible induce him to undertake better or more extensive researches. In many cases, they could excite local interest and could secure aid for him from the friends of his observatory, who might not otherwise know how important it was that his work should be aided. When a grant was made to an astronomer he should be made to feel that, in accepting it, it is he who confers the favor. He aids the committee in securing better results for their expenditures than they could otherwise obtain. Many astronomers are unwilling to ask for aid, owing to modesty, to motives of delicacy; or from fear that the results will not be considered adequate. If the members of the committee are satisfied that the object is a good one, they must take the responsibility of success or failure.

In many cases, they must ask advice of experts; in some cases they must employ them to investigate, or to try preliminary experiments. Often a preliminary appropriation should be made, its continuance or increase depending upon the results attained.

The seventh method described above stands on a wholly different basis from the others. Here the work must be done by experts, the greatest specialists in their departments. Many important investigations have been undertaken by international societies, and such work could be greatly increased if large sums of money were at their disposal for this purpose. As this is, perhaps, the greatest problem in astronomy it might seem presumptuous to discuss it further here.

A brief description of the attitude hitherto maintained by this observatory to other astronomers, is given below, and may explain its present policy in this matter.

One of the objects of the astronomical observatory of Harvard College, as stated in its statutes (*Annals*, Vol. I., p. lix), is 'in general, to promote the progress of knowledge in astronomy and the kindred sciences.' Various examples of the attempts to carry out this plan, by cooperation, publication of work done elsewhere, and in other ways, will be found in the *Annual Reports* and *Annals*.

In 1886 a definite attempt was made to secure the sum of $100,000, the income to be used in aiding other astronomers, and a pamphlet was published describing this plan. Four years later, Miss Catherine W. Bruce gave the sum of $6,000, to show what results could be obtained in a single year. This appropriation was distributed among fifteen astronomers, eight in Europe, one in Asia, one in Africa and five in North America.

The next attempt made by the writer was in 1901. It was thought that a committee representing the principal research funds of the country might render them more effective, and secure harmony in the expenditures of the money now available. Also, that a local committee could do more work than an international or even a national one, since more frequent meetings could be held. Delegates were therefore appointed by the Rumford Committee of the American Academy, and by the trustees of the Elizabeth Thompson Fund. The acting president of the National Academy agreed to attend the meetings unofficially. The members of the committee thus formed, the writer being also included, believed that a larger committee would render the work more effective. Additional members were invited, but no results were obtained.

Other plans were at once prepared, when the establishment of the Carnegie Institution entirely altered the prospects for original investigation in science in the United States, and rendered it probable that the immediate needs would be supplied from this source. No provision, however, has thus been made, so far as the writer is aware, for general aid to astronomers in other countries.

In April, 1903, a pamphlet was published showing how a large sum of money could be usefully expended each year for extending astronomical research. It was stated that much better results could be obtained by cooperation, avoiding duplication of work, providing astronomers with assistants and other means for undertaking neglected investigations, furnishing the means for employing the many large telescopes now idle, and, in general, attempting to improve the present quality and quantity of work done, regardless of individual or country. It was further proposed that the fund should be administered by a committee of astronomers, wholly unselfish and unprejudiced, the only object being to secure the greatest scientific return for the expendi-

ture, and that Harvard should act as trustee of this fund, on the ground of its security, permanency and success as an investor, and since the desire to aid astronomers throughout the world has not been made a part of the policy of observatories elsewhere.

A circular of inquiry was then printed and sent to all the members of the Astronomisches Gesellschaft, of the American Astrophysical Society, to about two hundred members of the Royal Astronomical Society and to a few others. It is believed that few astronomers widely interested in the progress of science, and whose opinion would be of much value, were thus omitted. The replies to this circular were very instructive and valuable, and I take this occasion to thank my friends for the trouble they have taken in the matter.

The following five questions were contained in the circular:

1. How do you think money could be spent most advantageously on astronomy at the present time?

2. Can you recommend any definite plan, in form for presentation to a possible donor?

3. In what way could money be most usefully expended at your observatory, or under your direction?

4. Can you give (not for publication) the names and addresses of any persons who are interested in your observatory, and who are able and might be willing to aid it, if the matter were properly presented to them?

5. What improvements do you suggest in the plan proposed for the endowment of astronomical research?

A discussion of the replies to questions Nos. 1, 2 and 3 would be given here, but it is believed that the writers would prefer a postponement of such action, until the establishment of a fund would enable a part at least of the proposed work to be undertaken.

Question No. 2 should have followed No. 3, as it was intended to refer to either No. 1 or 3. It was hoped that plans would be sent which could be enclosed in the letters proposed below, in discussing No. 4. If a large sum of money were already available, many definite plans would doubtless have been presented. The answers to No. 2 were in some cases covered by No. 1 or No. 3.

But few answers were given to question No. 4. I had hoped that an influential advisory committee could render important aid through this question. If the members were satisfied that an astronomer was doing excellent work and needed money for an important investigation, they could call the attention of the friends of his observatory to the matter very effectively. In many cases an astronomer would hesitate to do this himself, and the opinion of unprejudiced experts ought to have a weight that would not attach to the views of the individual concerned. I should be very much gratified if astronomers considered the work of the Harvard Observatory so important that they would take such action regarding the additional work I wish to undertake.

An excellent suggestion in reply to question No. 5 was made by Mr. A. R. Hinks, of the Cambridge Observatory, England. He recommended the publication of proposed forms of investigation, in order to secure the criticism of astronomers before, instead of after, it is too late to alter them. This seems to be especially important in the case of large pieces of routine work.

Few improvements or criticisms of the plan were suggested by foreign astronomers. One or two advised that the committee should be international, but probably the general feeling was that, as it was hoped to collect the funds in the United States, it

was only fair that they should be controlled by Americans.

Among American astronomers, however, strong objections were made to the part it was proposed that Harvard should take in the plan. For this reason two leading astronomers declined to serve even on an informal advisory committee. It was explained that this objection did not arise from jealousy of Harvard, or from fear that the plan would not be well carried out there, but from a belief that one observatory should not be more prominent than another in such a scheme, and that the control of such a fund and of its expenditure should be wholly independent of any one institution. I believe that the selection of a trustee for the care of the proposed fund should be made by the donor, and had expected that the informal advisory committee would have recommended some method of appointing the final committee, which would have secured unprejudiced action. The function of the first of these committees would have been to propose a plan like that described above. This want has been supplied, in a great measure, by my friends, Mrs. Henry Draper, Major E. H. Hills, Professor Simon Newcomb and Professor H. H. Turner, to whom I am indebted for important suggestions in preparing this pamphlet.

There are certain advantages to be gained by throwing the responsibility upon a single individual or institution, as all mistakes or failures can then be located and remedied. Continued efforts will accordingly be made by the writer to accomplish the desired results. As other observatories have not expressed a wish to aid astronomers elsewhere, there seems to be no objection to making it a part of the policy at Harvard.

The present discussion has been published to supplement that issued in 1903, a copy of which will be sent to those who desire it. It is believed that present conditions are unusually favorable for securing great progress in astronomical science. It is hoped that a sum of at least $50,000 may be obtained for immediate expenditure, so that a beginning may be made at once, and astronomers may have an opportunity to show what results they might obtain with unrestricted means.

My one object is to secure a real advance in astronomy. Any plan that will attain this will have my hearty support, if desired. If this advance is made, it is a matter of little importance whether the part taken by the Harvard Observatory, or by myself, is large or small.

EDWARD C. PICKERING.

July 11, 1904.

THE CHANGING ATTITUDE OF AMERICAN UNIVERSITIES TOWARD PSYCHOLOGY.

IN this adolescent period of its growth, psychology may be pardoned for wondering if its elder brothers understand the manhood it is attaining. The distortion by the public prints, in their eagerness to be a little more than up-to-date, has thrown numerous fads of 'mental science' out of all perspective, and resulted undoubtedly in the injury of psychology. At the present time, however, the general reader is learning to discriminate 'yellowness' in what purports to be psychological news. When the Sunday special announced in January of this year that the soul of a rat had been observed in the laboratory of a Washington psychologist, few had difficulty in pigeon-holing the article with another which declared, about the same time, that a California physicist expected to turn negroes into white men by the use of radium. In the following pages the writer collects certain facts which bear upon the recent development of psychology in American institutions of higher learning, with the hope of giving more adequate means for judging the present status of this sci-

ence. The data are taken from the catalogues of 150 colleges and detailed information furnished by the directors of 34 prominent laboratories.

Ten years ago, Binet stated in the opening chapter of his 'Psychologie Expérimentale' that there were 14 laboratories in Europe and 16 in America. To-day there are at least 54 universities in the United States and Canada having psychological laboratories. The equipments of 25 of the largest average in value over $4,000, while in 1893 it was estimated* that the total psychological equipment in the United States was worth approximately $30,000. This material prosperity, small as it is, becomes noteworthy when it is considered that 1904 marks only the twenty-first anniversary of the establishment of the first American laboratory.† Experimental psychology in this country is just becoming of age.

A more important advance than this acquisition of apparatus is the change in the character of instruction in the institutions of higher learning. Some introduction to descriptive psychology, under the title of mental philosophy, was part of the established order even in the early American colleges. At first it fell often within the province of the president to teach psychology and philosophy. Among the institutions which to-day have 15 or more in their faculties, the presidents of only nine preserve their colonial function of occupying the chair of philosophy. Moreover, there are only five among the 150 institutions‡ studied in this paper, in which no instruction in psychology is given. These five are Catholic schools.

Psychology is now organized as an entirely separate department in four universities, and there are professors or assistant professors having the title in psychology in about 30 others. The administrative arrangements in these latter are such as to associate psychology in the same department with either philosophy or education. In the middle west, especially, we find a movement to connect psychology and pedagogy. This is true of Colorado University, Cornell College, Upper Iowa University, South Dakota University, Illinois University, Ohio State University and the New York University School of Pedagogy. In all the other colleges psychology preserves its old affiliation with philosophy. On account of its intimate relation, as a pure science, to the philosophical disciplines, the close connection of these two departments may be expected to long continue. Many of the professors in both subjects regard it to their mutual advantage to preserve this condition. If we ought not to expect the growing strength of psychology to be manifested in the establishment of independent departments, we may yet find it shown in the size of the instructional force. There are to-day 45 colleges employing more than one person to give courses in psychology. The largest faculty in psychology is found at Columbia, where eight men give their entire time to the subject and four others give part time. Seven universities employ five or more for instruction in psychology.

The department organization, as above outlined, shows less progress than the rapid differentiation of the subject matter taught. Subdivisions have increased in number and strength, until recently a specialist in the application of psychology to teaching was made 'professor of educational psychology.'

* 'Report of the United States Commissioner of Education,' II., 1139.

† Founded at Johns Hopkins by G. Stanley Hall.

‡ The colleges were selected on the basis of the size of their faculties, as shown by the Report of the U. S. Commissioner of Education for 1901. All institutions of college rank having 15 or more in their faculties were taken; 95 of them had faculties of 20 or more members.

Comparative psychology, which considers the mental life of lower animals, no longer retains its place on the skirmish line; separate instructors, rooms and equipment mark its permanent position in the university. Twenty-two colleges now offer curriculums with comparative psychology cited as an independent course. In planning for the new laboratory in Emerson Hall, Harvard, a comparative psychologist went to Europe expressly to study the German 'institutes,' so as to be ready to introduce the most perfect arrangements for studying the psychology of animals. Besides these subtopics there are a score or more of others treated in separate courses by officers of the psychological departments. Intimately related subjects, like anthropology and sociology, have become university departments. The instructors in psychology, in addition to the familiar courses in descriptive and experimental psychology, are teaching such phases of the science as physiological psychology and abnormal psychology; genetic psychology and child study; historical, analytical and systematic psychology; the psychology of the emotions and will, the psychology of logic, of esthetics, of ethics and of religion; the application of statistical methods to psychology; experimental phonetics and various other investigations in special fields. There are at least 62 colleges where three or more courses with psychological titles are announced in the catalogues; 38 give five or more courses. At Columbia the department of psychology alone offers 20 different courses. The present differentiation in psychology is more noticeable when compared with the condition ten years ago. Professor Delabarre, writing at that time for *L'Année,* outlined the courses in the 26 American institutions. Only 16 then offered as many as five courses.

Turning from the attitude of the faculties toward psychology to the opinion among the students, the data which have been furnished by the laboratory directors are suggestive.* The student view is certainly of vital importance; psychology must depend largely on it for the future. The records at hand approximate the registration in psychological courses among 34 universities, each of which has a laboratory equipment worth $1,000 or more.† In trying to estimate the importance of psychology in the work of the student body, the registration in this department may be compared with the total enrolment of the colleges in which psychology is offered. These are only the graduate school and the colleges of pure science, of literature and of arts. The class rolls in psychology for the group of universities studied include this year from 10 to 50 per cent. of the students to whom it is offered.‡ Clark University, where the enrolment in psychology reaches about three fourths of the students, ought to be considered apart. Its position in regard to graduate study in psychology is unique on account of the prominence of President G. Stanley Hall, which has attracted a group of students with psychological interests. By omitting Clark our average becomes quite representative of conditions in the larger institutions; we find that the attendance on psychological courses is approximately 20 per cent. of the total enrolment. It seems fair to suppose that a third of the students in these 34 institutions, even in the colleges of science, literature and arts, can not

* I wish to take this opportunity to thank some fifty professors who have shown much consideration in supplying information regarding attendance on courses, laboratory equipment, etc.

† For a list of the institutions considered, see the discussion of laboratories, later in this paper.

‡ It has not seemed advisable to try to exclude double registrations in psychology, as they are comparatively few, and as in some cases only the approximate enrolment has been furnished.

register for psychology. Freshmen are excluded in all but eight, while eight do not admit even sophomores. The average enrolment in psychology would, therefore, mean that about 30 per cent. of the students to whom it is offered are taking some course in this department. With the shifting registration during the last three years in college, when the subject is generally taught, it is hardly claiming too much to suppose that 60 per cent. of the graduates from the larger universities in America today have taken at least an introductory course in psychology. When it is remembered that psychology is required for graduation in only eight of these larger institutions, the popularity of the subject among students can hardly be questioned.

Any ranking of the universities as to attendance in psychology would have little meaning on account of the numerous local factors which affect the enrolments. In some institutions an introductory course is required of all juniors; again we find that the percentage is reduced by the student interest scattering among the many prominent professors in large universities. The percentage of students studying psychology in Harvard, Yale and Chicago, for example, is in each case slightly below the average, while the number of students to whom they offer psychology is larger than anywhere else except Columbia. At the last-named institution the percentage reaches 32, but the students are required to take an introductory course, which is left optional in the other three. Cornell occupies a medium position; its enrolment in psychology is just 20 per cent. By comparison with reports from the other laboratories, the distribution of students among the various courses given at Cornell seems to be quite typical. In detail it is as follows: Number of students in the colleges where psychology is offered, 1,200; attending the introductory courses in psychology (open to sophomores), 175; the experimental course (open to juniors), 30 students for one semester, 20 continuing for the year; the research courses, 6 graduates doing major work and 6 undergraduates taking up minor problems; the psychological seminar, 15 students, limited.

Some idea of the actual number studying psychology may be gained from the fact that the introductory classes at Columbia, including Teachers College and Barnard, show an enrolment of 435 students; at Harvard, 300; Princeton, 250; Nebraska, 225; Cornell, Minnesota, Toronto and Wellesley, 175. The interest manifested by graduate students in productive work is best illustrated by a quotation from the address of Professor Cattell, as chairman of the section of anthropology of the American Association for the Advancement of Science: "In the year 1897 there were given by American universities eighteen doctorates with psychology as the major subject —more than any science except chemistry, six times as many as in astronomy, and nine times as many as in anthropology."* A summary published in 1903 showed that in five years the number of doctorates in psychology had been 68. Only three other sciences were credited with more—chemistry, 137; zoology, 72; and physics, 69.† Each of these doctorates meant the completion of an original investigation in the field of the major subject.

In winning its way to favor among scientific men, psychology has depended largely on its experimental work. The improvement in quality can only be apprehended by comparing the recent volumes of the technical journals in psychology with those of ten years ago. The adoption of new statistical methods, the use of correlation in studying psychological problems, the

* Science, VIII., 533.

† Science, April 10, 1903.

revolution in educational psychology which is placing its research on a very different basis than enumeration of answers to questionaires; these and other changes have introduced quantitative work in a way that was regarded as almost impossible a decade ago. That the students are acceding to this demand for training in refined methods of measurement is partly attested by an average enrolment of 25 students in laboratory courses in 34 institutions where the best facilities for this work are offered. In 19 of these universities we find seminars devoted distinctly to psychological problems. Still more encouraging is the fact that more than a hundred graduate students are to-day carrying on research in residence at these laboratories, while 63 undergraduates are investigating minor problems. Few other sciences can show an equal record, and certainly no other country approaches the United States in the number occupied in zealous psychological research.

It is ten years since any comprehensive survey of American facilities for psychology has been published. At that time Professor Delabarre described each of the laboratories in the United States, 26 in all.* A separate account of each laboratory is to-day out of the question. We must content ourselves with tabular statements. A study of the larger laboratories shows that they fall conveniently into three classes on the basis of the value of their equipment. This grouping, it must be remembered, is for convenience and is not intended to indicate the relative importance of the laboratories. The first group embraces those which have apparatus and fixtures valued at \$10,000 ± \$2,000. This includes: Clark, Columbia, Cornell, Harvard, Pennsylvania and Yale. A second group contains those the equipment of which ranges in value between \$5,000 ± \$2,000. In it are Brown, Chicago, Indiana, Iowa, Michigan, Princeton, Toronto and Wisconsin. The third group embraces all the other laboratories here studied. The equipments are valued between \$1,000 and \$2,000. It includes Bryn Mawr, California, Cincinnati, Colorado, Illinois, Indiana, Kansas, Leland Stanford, Jr., Minnesota, Missouri, Mount Holyoke, New York University School of Pedagogy, Northwestern, Ohio State, Randolph-Macon Woman's College, Texas, Vassar, Wellesley and Wesleyan. Under this arrangement the average equipments of the universities in each group are approximately \$10,000, \$5,000 and \$1,500, respectively.

The income of the laboratories might better express their potential value. Annual appropriations for improvement range from \$100 in a few of the smallest to \$1,000 in five of the largest; the average is slightly over \$400. These sums are small considering the needs, but, nevertheless, represent a condition which means the doubling of the equipment about every ten years, even if the generosity of the university authorities is not further awakened. In spite of the constant increase in equipment, the directors of the best laboratories are seriously embarrassed in trying to meet the demands made upon them for instruction in experimental work. The opening of tempting fields of investigation has to be postponed until the needs of the present courses are met.

Another mark of the material development of this youthful science, and particularly of the large research interest in the subject, is found in the increasing space occupied by the department in the university buildings. In the following institutions ten or more rooms are now devoted exclusively to psychology: California, Chicago, Clark, Columbia, Cornell, Harvard,

* *L'Année*, I., 209–55.

Indiana, Iowa, Leland Stanford, Jr., Michigan, Pennsylvania and Toronto. Yale should be grouped with these on account of its plan to retain a very large room for undergraduate experimental work, instead of dividing it up as is done elsewhere. On an average, eight rooms are occupied by psychology in the group of universities considered. The further scientific progress of psychology is assured by a general plan to provide as many separate rooms as possible to be used for research work. Six out of the eight rooms are usually available for special investigations. On account of the necessary isolation of the experimenter in psychology, this provision is of vital importance to the science.

The demand made upon the laboratories for research equipment is reflected also in the establishment of complete workshops in connection with the department. The psychological workshop has reached its most prominent development at Yale and Columbia. At New Haven the equipment of the shop is valued at $2,000. A teacher of manual training spends half his time during the school year and all of his time during the summer working for the department. A student also frequently assists in the shop. At Columbia a skilled instrument builder and a boy assistant are employed the year around; the value of the shop equipment is approximately $1,000. Cornell is soon to add a new workshop to its splendid laboratory equipment. It has for some time employed a mechanician half the day. Several of the laboratory directors prefer to have large pieces of apparatus built outside the department, and, therefore, maintain only a small shop for repairs. Of the 34 universities, all but seven have made provision for at least a work-bench and tools in the department.

To judge the worth of a laboratory on the basis of floor space and dollars invested is certainly unwise; yet size and capital are not unimportant considerations, even when comparing institutions of learning. An interesting classification of a different nature is suggested by the 'Statistics on American Psychologists,' recently published.* The ranking indicates something of the past performance of the older laboratories. The article considers 200 psychologists and tabulates the institutions that have contributed to their academic training (undergraduate and graduate). The seven highest rank as follows: Columbia, 42; Harvard, 42; Cornell, 27; Yale, 23; Princeton, 20; Pennsylvania, 17; Johns Hopkins, 13; 66 other institutions have also taken part in stimulating some of these prominent psychologists. It is recognized, of course, that this ranking overestimates the time that the laboratory has been in service. In proportion to the number of students working in certain younger laboratories, it may be said that the contributions to the science which they are making is often fully equal to the splendid achievements of those longer established.

In one respect the American laboratories differ distinctly from the German. The latter are often impressed by the personal interest of their directors, which shows itself in some special line of investigation. The laboratory of Stumpf at Berlin, with its complete technical equipment for auditory work, is a striking example. It may be said, however, that certain tendencies do seem to characterize a few of the older laboratories in this country; although in no case do they interfere with a broad teaching of all phases of psychology. In this science, as in all others, the American university first of all teaches, and teaches well. Nevertheless, the trends of thought which prevail among graduate students at present suggest that those who are funda-

* J. McK. Cattell, *Amer. J. of Psychol.*, XIV., 324.

mentally interested in philosophy gravitate to Harvard; those seeking primarily the scientific attitude find Columbia congenial; Cornell is the best university to place the student in touch with the historical development of experimental work and of systematic psychology; Clark is most widely known for its pedagogical interest in the science; Princeton for the biological interpretations of Professor J. Mark Baldwin; Yale for training courses in psychological measurement; and Pennsylvania for the introduction of extended experimental work into its sophomore introductory course in psychology. Nearly all the larger laboratories have some feature in which they are better prepared for specialization than their contemporaries. Only an extended study of the products of each would reveal these fruits of successful development along particular lines.

Satisfactory as have been the gains in the past, there are signs which point to fully as large growth for psychology in the near future. That the reader may sense more vividly the increasing stature of the science, there are given below the condensed statements of laboratory directors as to definite improvements now contemplated or just completed:

Harvard.—New quarters for the psychological department are to be provided in Emerson Hall, the $200,000 building which is now being constructed for the exclusive use of philosophy and psychology. The laboratory will occupy the third story, 22 rooms. Sixteen rooms will be available for research. Library, seminar and lecture rooms will be located on the other floors.*

Johns Hopkins.—No detailed plans made as yet, but a fully equipped psychological department and laboratory will be established by Professor J. Mark Baldwin, who previously founded laboratories at Toronto and Princeton, and has recently been called to this university. Professor George M. Stratton, of California University, has also been secured by Johns Hopkins for the work in psychology.

Leland Stanford, Jr.—The department has moved this year into new quarters, which Professor F. Angell expects to have fully equipped with apparatus in about eighteen months. The new arrangement provides a lecture room for a hundred students, a library and seminar room, two office rooms (one of which may be used for research), a work room, two dark rooms, a silent and dark room, five large closets for storage, drum smoking, lockers, etc., and nine other rooms for investigation and instruction.

Michigan.—A one-story building, 125 x 35 feet, this year was assigned to the psychological department. It provides 15 rooms, including two dark rooms, all provided with water, gas, low and high potential electric currents.

Cornell.—The building of the new Goldwin Smith Hall will provide a demonstrational laboratory, equipped by a special appropriation, and also a large lecture room fitted up for psychology. Besides this addition, the present quarters in Morrill Hall will be increased by adding at least two rooms and possibly as many as eight. A new workshop with improved equipment has been provided this year. It is the plan at Cornell to buy three or four big pieces of apparatus annually, pieces like the Wundt tachistoscope, the Helmholtz vowel apparatus, etc. New apparatus for quantitative drill work and for class demonstration has been built recently.*

Pennsylvania.—In 1903 a lecture room with a seating capacity of 50 was equipped with laboratory tables and with lockers for

* Hugo Münsterberg, *Harvard Graduates' Magazine*, IX., 424–433.

* E. B. Titchener, *Amer. J. of Psychol.*, XIV., 175–191; XV., 57–61.

each student. Another large room was divided into seven small rooms, principally for use in research. These rooms are all wired for telephones and electric currents. The two improvements cost $2,000 and Professor Witmer expects to spend from $1,000 to $2,500 in the near future in further fitting these rooms for original investigation. He will then have a time room, rooms for chronoscope and chronograph, a subject reaction room, small and large dark rooms (the latter 50 feet long for visual experiments). Special provision is to be made for readily making psychological tests on normal and defective children. Within the next two years the department expects to secure two additional rooms.

Clark.—The organization of philosophical and psychological departments in the college has taken place this year; Professor C. E. Sanford gives the courses in philosophy and James P. Porter those in psychology. An appropriation of $1,500 was made for fitting up this new department in addition to the graduate laboratory in charge of Professor Sanford.

Nebraska.—The department is to have seven rooms, 2,400 feet of floor space, on the upper floor of the new physics building, now being constructed. At present it has four rooms.

Wesleyan.—A suite of four rooms became available for the department this spring; only one room was used previously.

Vassar.—A thousand dollars was appropriated in 1903 to establish a psychological laboratory under the direction of Dr. Margaret F. Washburn.

Bryn Mawr.—The department will move next year into a building now being constructed and will occupy five rooms, instead of four as at present. An assistant in the laboratory was added last year.

Yale.—Dr. C. M. McAllister was this year appointed instructor and W. M. Steele made assistant in the laboratory. Apparatus necessary for the experimental course is being duplicated so as to provide a complete equipment for each group of two students.

Texas.—Psychology in charge of Dr. Warner Fite is this year given apart from the school of pedagogy.

Wisconsin.—Professor Jastrow contemplates adding rooms equipped for comparative psychology and the employment, together with other departments, of a mechanician. A shadowless room for stereoscopic research has been constructed this year.

California.—An instructor in experimental psychology, Dr. P. S. Wrinch, was added this year to the instructional force.

Chicago.—Professor James R. Angell expects a new building for psychology eventually, although not immediately.

Minnesota.—New quarters are expected if a building is constructed for history, political science and philosophy.

The recent record of psychology makes it plain that a statement of Professor Titchener, of Cornell, made in 1898, has now become trite. Speaking of psychology in an article in *Mind,* he said: "The training that can now be obtained in the American laboratories is at least as good a fitting for work in an American university as can be gained in Germany."* America has excelled Europe in psychological equipment for ten years. That the progress has not stopped with gaining an advantage in value of equipment is a matter of congratulation. In promoting this younger science, the young nation has not hesitated to continue to enlarge the opportunities for psychology, trusting to the workers in the science to refine the quality of the output.

The foregoing paper has aimed to bring

* 'A Psychological Laboratory,' *Mind,* N. S., VII., 330.

together various views of psychology that may be gained from a university standpoint: The enlargement of the portion of university appropriation devoted to this science; the broadening interest and increasing specialization within the department of psychology itself; the advanced position attained in the university faculties; and the growing favor among students and among scientific investigators. In the history of this institutional development the psychologists themselves deserve much credit. They have continually justified the confidence placed in them by intensifying their instruction and by increasing the merit of their literary and research contributions, until to-day these rank with the best of any nation.

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SCIENTIFIC BOOKS.

Gems and Gem Minerals. By Dr. OLIVER CUMMINGS FARRINGTON, Curator of Geology, Field Columbian Museum, Chicago, Ill. Chicago, A. W. Mumford. 1903. Imperial 8vo. Pp. xii + 229, with plates in color and black and white.

This work is a popular and comprehensive book on the subject of precious stones, treating of their finding, cutting, history and chemical composition. It is intended to supply a long-felt want for an inexpensive popular treatise adapted alike to the mineralogist, the jeweler and the general reader; and the work is one full both of illustrations and information. The nature of the leading gems, their occurrence, their mining, their color, luster, hardness and specific gravity; their optical properties, their crystalline form, their cutting, and the various superstitions connected with them, are treated in successive chapters in the order named. The minor gems follow in their natural sequence, a chapter or part of a page being devoted to each of the principal species and varieties. The volume is printed on good paper, and in large clear type. The illustrations are of two kinds, in colors and in black and white, the latter giving maps of gem regions, methods of mining and the various forms of natural and cut stones, most of the maps being made by half-tone processes and many of them very exact. The special feature of the work, however, is found in the numerous plates produced by the three-color process, and in most cases direct from the objects themselves. The application of this method makes possible a vivid presentation of most of the varieties of precious and semiprecious stones, almost exactly true to nature, a result which of course could not be attained by any black-and-white process.

Some of the plates prepared for this book have already appeared in that excellent and instructive popular publication, 'Birds in Nature,' issued by the same publisher, whose reprints of birds and other natural objects have been adopted by many educational institutions for use in teaching, in so much that more than 100,000 plates have been ordered by a single school committee. Others of the plates are reproduced from the great work, 'Edelsteinkunde,' by Dr. Max Bauer, who was one of the first to utilize the three-color method with success.

Dr. Farrington has had peculiar advantages in preparing such a work, from his position in charge of a great reference collection. This is based on the Tiffany collection of gems gathered for the Columbian Exposition at Chicago in 1893, and subsequently purchased for the Field Columbian Museum, where it is now installed in Higinbotham Hall. It is the best book published up to the present time as regards text, illustration and exact facts for a low price and useful to every mineralogist or collector of gems.

The color work in the gem plates compares remarkably well with the three-color work of Ives, who has attained excellent results, more particularly, however, with porcelains, enamels, pottery, etc., and is somewhat in the line of the plate illustrating North American gems issued by the U. S. Department of Mining Statistics in its report for 1899.

The Heliotype Company, of Boston, Mass., also, have printed (unpublished) a most re-

markable color reproduction of a slab of Mexican onyx, which for realism and beauty is as yet unrivaled.

It is not, of course, within the province of an inexpensive work like this to furnish such splendid plates as those illustrating the Heber R. Bishop book on jade—notably the lithographic work of the art objects by Prang, and of the archeological objects by Forbes, of Boston; or the etchings of the French artists, which were colored by being rubbed in with the hand, on the etched plates, that is, the color and the tintings were applied to an etching plate, giving both an artistic as well as a realistic and charming effect; or some of the Chinese wood-cuts, made by the artists in their own homes, from native specimens, and printed on the thinnest paper, which was then mounted. Dr. Farrington's volume contains thirteen plates, while Bauer's great book has twenty in color; but 'Gems and Gem Minerals' contains about one sixth the text of Bauer's book, and sells at one fifth the price.

To digress for a moment from the review, a few words upon color illustration may not be amiss. Illustrations for works upon science and art have become possible, both in kind and in cost, within recent years, by the wonderful advances in photographic reproduction, to a degree that is indeed remarkable. Plates that are almost perfectly true to nature can now be furnished in black and white at one tenth the cost of producing them twenty years ago; and color illustrations are now within the reach of students of entomology, ornithology, and, indeed, almost all branches of zoology and botany, to an extent formerly impossible. The realistic effect of such illustrations is often admirable; and these processes can be used in a multitude of cases where either lithographic or hand-colored work would be out of the question on account of its far greater cost. These expensive processes remain for luxurious and elaborate works, in which cost is not considered; but the half-tone and three-color methods have an immense and most valuable field in educational and popular uses. The question whether a book is to be a commercial success, when sold at from two to ten dollars a copy, or is to be privately printed in a limited edition, for distribution as a gift by a wealthy man or a large institution, regardless of cost, for the purpose of describing a great collection, naturally involves an immense difference in the character of the make-up.

Among the first successful attempts to apply colored illustration to this department of natural objects, were the plates in the volumes by Sowerby, on British and exotic minerals, published in the early part of the last century. In other branches, especially in ornithology, entomology and botany, hundreds of volumes have been illustrated in color, often with great accuracy and beauty, in a manner rarely employed in mineralogy or geology. This difference may be due in some degree to the fact that birds, insects and flowers have greater interest than minerals for the general public; but it is also largely caused by the difficulty of reproducing successfully the peculiarities of crystalline form, especially when grouped, and the varying effects resulting from differences in luster and transparency. Among the first to avail themselves of the new processes, in a popular point of view, were Messrs. Funk & Wagnalls in the gem and other colored plates in their Standard Dictionary. The bird and similar color illustrations of Mr. Mumford have already been noted, and their extensive adoption in schools, etc., thoughout the country. One of the latest and best examples of fine color work is in the monumental treatise on Indian baskets, by Dr. Otis T. Mason, recently published by the Smithsonian Institution. All these, however, notwithstanding their beauty and fidelity, and their great general value, can not be compared with such splendid illustrations as those of the North Carolina Geological Survey, which is now publishing a volume upon 'Gems and Precious Stones,' to contain four colored plates, by Taber Prang Art Company, or the Bishop jade catalogue, already referred to, or the great forthcoming work describing the Morgan collection of porcelains, which will consist of an edition limited to 250 copies, and will be of regal elegance in every way;

or the new description of the Morgan gems, which is to present the finest combination of realistic accuracy and artistic beauty yet attained. GEORGE F. KUNZ.

Laboratory Exercises in Physical Chemistry. By FREDERICK H. GETMAN, Ph.D. New York, John Wiley & Sons. 1904. Pp. 241.

Laboratory manuals in physics and in chemistry separately have been put upon the market during the last twenty years in sufficient number to satisfy all reasonable demands on the part of the general public. But during this interval a field that overlaps both of these has become differentiated, the start being made by Ostwald, whose work has been taken up and enlarged by a considerable number of ardent workers. Many of the laboratory operations involved are not provided for in the current manuals in English. Ostwald's 'Physiko-Chemische Messungen' and Traube's 'Physikalish-Chemische Methode' cover the ground well in German, but, as is so often the case in German books, the amount of detail involved in the effort to be exhaustive, and the large number of references to researches not easily found in most American college libraries, deprive them of much of their value for American beginners.

Dr. Getman's admirable little book has been prepared with constant recognition of the American demand for directness and economy. His own experience during the last few years in Johns Hopkins University, where physical chemistry was the subject in which his doctor's thesis was prepared, has been linked on to several years of previous experience in the teaching of chemistry. His effort has been to select only such methods for presentation as he has found to be typical and worthy of preference. He has very decidedly the teacher's instinct, exhibiting much aptitude in the art of arrangement and of clear expression. Although the book is not yet two months out of press, it has been already adopted in a number of university laboratories. It certainly meets well the needs of the beginner in physical chemistry and is worthy of special commendation as a handbook.

The range covered may be briefly indicated. In the introductory chapters the author discusses the theory and use of the balance; volume and density; viscosity and surface tension; and the determination of solubility. Thermometry and calorimetry are then considered, and a chapter on optical measurements is introduced. This is followed by several chapters on electrical measurement of conductivity, electromotive force, current and the dielectric constant. The last chapter is on chemical kinetics as illustrated in reactions of the first order, like the inversion of cane sugar, and of the second order, like certain cases of saponification.

The book closes with a well-selected series of tables and an index.

W. LE CONTE STEVENS.

DISCUSSION AND CORRESPONDENCE.

THE USE OF ROMAN NUMERALS.

ROMAN numerals are frequently used to designate the volume of a serial in bibliographic references. Instead of writing Vol. 88, or merely 88 after the name of the serial, we go to the trouble to write LXXXVIII. Why? Simply because we have seen others do it, and have unreflectively imitated them. When we are forced to defend our usage we find that there are few reasons for the use of the Roman system, whereas there are many reasons for the use of the Arabic system. Those who are intelligently in favor of the Roman numerals in bibliographic work argue that the use of them enables us to avoid the abbreviation for volume, while at the same time we thus distinguish sharply between volume and part, or volume and page. They, furthermore, urge that it is well for us to conform to the usage of publishers. But these arguments should be considered in the light of the following facts.

Although no one would deny that it takes much longer to write and read the Roman numerals than the Arabic, and that we are far more likely to make mistakes in dealing with the former system, few of us realize how great the difference in the ease and accuracy with which we use the two systems really is. In order that my arguments for the use of Arabic instead of Roman numerals, not alone

in bibliographic work, but also in all cases where there is no clear advantage in favor of the more cumbersome system, might have the support of quantitative data I have chosen ten well-educated, and in most cases scientifically trained individuals, and determined for each the time necessary for the writing of the Roman and the Arabic numerals from 1 to 100 and the number of errors made, also the time necessary for the reading of the Roman and the Arabic numerals from 1 to 100 when they were irregularly arranged so that the reader did not know what order to expect. In all cases the number of errors made unconsciously was recorded. These measurements furnish the following startling averages: *It takes three and one third times as long to write the Roman numerals from 1 to 100 as the Arabic, and the chance of error is twenty-one times as great; it takes three times as long to read the Roman numerals from 1 to 100 as the Arabic, and the chance of error is eight times as great.*

In case of a quick and accurate mathematician, whose familiarity with the Roman system surpassed that of most of the individuals tested, the results were: time for writing Arabics, 107″, errors, 0; time for writing Romans, 357″, errors, 5; time for reading Arabics, 62″, errors, 2; time for reading Romans, 131″, errors, 5. For one well-trained scientist, who has cause to use the Roman system almost every day, the number of errors in the rapid reading of the Romans was 15!

These figures certainly indicate the desirability of using the Arabic system wherever there is no urgent need for the simultaneous use of two or more systems of numerals. Even if there were no saving of time and strain by the avoidance of the cumbersome Roman symbols, the far greater accuracy gained by the use of the Arabic system should at once settle the matter for all scientists.

Robert M. Yerkes.

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[The best usage in bibliographic work is to use heavy-faced Arabic type for the volume number. The number should be underlined in the manuscript with a waving line, and it will then be set in heavy-faced or block type by the printers. This usage we think originated in American botanical publications. The volume number in heavy-faced type is followed by a colon and then the page numbers are given in ordinary type. The date or year then follows after a period, though we should suppose that a comma would be better. The International Catalogue of Scientific Literature has adopted the heavy-faced type for the volume number; this is followed by a comma and the year, the page numbers being then given in parentheses after another comma. We think that the American usage is the better and should be pleased if our contributors would follow it. The pages of the International Catalogue are disfigured by hundreds of thousands of needless parentheses and periods.—Ed.]

SPECIAL ARTICLES.

PUPATION OF THE KELEP ANT.

The larvæ of ants share with those of butterflies and moths the habit of spinning cocoons in which their transformation to the adult form takes place, though not all the ants make cocoons. Lubbock states that 'as a general rule, the species which have not a sting spin a cocoon, while those which have are naked,' the implication being, apparently, that less protection is required by species having stings with which to defend themselves. It would seem, however, that the absence of the cocoon rather than its presence is to be looked upon as the adaptive character. The keeping of the insects from drying out during the inactive period of transformation is probably a more important general function of cocoons than that of protection against enemies, but the moist underground chambers and compact social organization of the ants have rendered cocoons unnecessary, and in many genera they have been dispensed with.

The family Ponerida to which the kelep*

* The kelep has been identified by Dr. Ashmead and Mr. Pergande as *Ectatomma tuberculatum* Oliv., a species widely distributed in tropical America, including Mexico, and hence the more likely to become established in Texas. It does not follow, however, that the instinct of attacking the boll-weevil is possessed in an equal degree by

belongs is a primitive group, and breaks Lubbock's rule by retaining both stings and cocoons. Its method of pupation is, therefore, of special interest, and has been recently observed at Victoria, Texas, by Mr. G. P. Goll, whose summarized report reads as follows:

August 1. 5 P.M. Another larva is ready to pupate and two keleps are industriously attending it. One seems to be cleaning the larva, while the other is depositing earth around its head.

7:30 P.M. Six ants are now covering two larvæ with earth, while the latter are continually squirming about and disturbing the earth thus piled over them.

10 P.M. One larva is completely covered and the other almost so.

11:25 P.M. Two ants are removing the earth from the first larva covered, showing that it has spun a cocoon. The other larva is completely covered, and third is being worked upon.

11:35 P.M. The first cocoon has been taken to another chamber and the particles of earth are being removed.

10:10 next morning. The third larva which was being covered at 11:30 last night has finished its cocoon, and has been carried away. This is the fourth larva that has pupated since 4 P.M. yesterday, in eighteen hours.

From these and other observations the following facts and inferences have been reached:

The larva is entirely covered with earth when ready to pupate.

This earth is necessary as a basis for the cocoon.

The squirming and apparent objection on the part of the larva is an instinctive action to keep the earth from being packed too close around it, and thus not give it room enough to spin.

Time required to cover larva with earth, about six hours.

Time required for the larva to spin its cocoon so as to permit removing to another chamber, one and one half hours.

The color of the cocoons changes with age from a light gray to a pale reddish brown.

Although the matter seems not to have been considered by Lubbock and other investigators of ants, it is easy to understand that, as Mr. Goll says, the earth or some other material is necessary to furnish support for the cocoon. The naked larvæ lying about on the level floors of the chambers would have no means of supporting their silk in the air, nothing against which to spin. The majority of the lepidoptera and other insects go into the ground to pupate, with or without cocoons. Those which spin cocoons above ground generally wrap themselves up in leaves or seek crevices, corners or forks of branches, across which their outer network of threads can be fastened. It seems probable, therefore, that this curious habit of building earth cells for the pupating larvæ is no recently acquired instinct peculiar to the present species or its immediate relatives. The problem is as old as the social organization and nest-building habit of the ants, and the usual variety of solutions may be looked for among the many cocoon-making species.

The extensive labor involved in helping the young ants to pupate makes it easy to understand why so many members of the group have discontinued the process. The time used in making the earth cell is in some instances much greater than that reported by Mr. Goll. One of our larvæ was surrounded by a row of pellets of earth for over twelve hours, and, though lying quite still, was continually attended by three or four worker ants, waiting, as it were, for the final emergency. The use of earth in pupation constitutes a further reason why the earth and stone nests built into glass jar cages,* like those in which the ants were brought from Guatemala, afforded a better method of handling and observing them than the horizontal glass plates or plaster-of-Paris cells hitherto generally employed by

all the members of the species; otherwise this habit could scarcely have remained so long unknown. The occurrence of the kelep in Mexico is rendered somewhat doubtful, moreover, by the fact that the Mexican *Ectatomma ferrugineum* Norton, which Forel treats as a synonym of *E. tuberculatum*, may prove to be a distinct species. The National Museum has specimens from Mexico which agree well with Norton's description and figures, but offer appreciable differences from the keleps. The habits reported by Norton for his *E. ferrugineum* are also not those of the Guatemalan ants. "This species is found only in the *encinales*, or oak forests of the hot and temperate region, where it lives in little societies under the trunks of fallen trees."

* 'Habits of the Kelep or Guatemalan Cotton Boll Weevil Ant' Bull. 49, Bureau of Entomology, U. S. Dept. Agriculture, p. 6, Washington, 1904.

entomologists. In addition to much greater facility in capturing, transporting, feeding and keeping them moist, the ants are placed under much more natural conditions and may be expected to show more normal behavior.

O. F. Cook.

Washington, D. C.,
August 17, 1904.

IMPORTANCE OF ISOLATED REARINGS FROM CULICID LARVÆ.

The fact that four, five or more species of larvæ occur in association in the same pool, renders it difficult to separate the various species, especially as living larvæ resemble each other very closely. Particular attention has been paid to this phase of the subject during the present season with very gratifying results, as may be seen from the following:

A larva somewhat resembling and associated with *Culex impiger* presents marked differences in that the dorsal surface of the air tube is provided with a double row of hairs, each row consisting of about four tufts composed of a pair of weakly barbuled hairs. This is undoubtedly the larva which Messrs. Dyar and Knab* have confused with that of *Culex impiger*. From this larva a large, brownish-gray mosquito 6 to 7 mm. long, with the curved scales of the head white, was obtained. This species has been given the name of *Culex cinereoborealis* n. sp.

A larva somewhat resembling that of *C. impiger* was met with in a cold mountain pool at Elizabethtown, N. Y., June 9, adults emerging on the tenth and closely resembling those of *C. impiger*. The larva may be easily recognized by the conspicuous, triangular comb composed of about sixty rather large scales, each tipped with from four to seven stout, equal spines. The air tube is short, a little over twice as long as broad, slightly swollen at the basal third and bearing a double row of posterior pecten, each consisting of about twenty short, black, stout spines. The adult, *Culex lazarensis* n. sp., may be distinguished from *C. impiger* by its large size, it being 6 to 7 mm. long, and the vittate thorax with two dark lines. The wing of the female *C. lazarensis* is longer, the second longitudinal vein, particularly at its fork, is straighter, and the second fork cell is shorter and broader than in *C. impiger*. There are also marked differences in the male genitalia.

Another very interesting larva was met with June 14 in a cold mountain pool at Elizabethtown, N. Y., and may be easily recognized by the comb consisting of but six to seven thorn-like scales arranged in a curved line, with a large, finely setose, spatulate base and with a stout, apical spine. The air tube is about three times as long as wide, tapering regularly and with double posterior pecten on the basal third, each row consisting of twelve to fifteen closely set, stout spines, each bearing near the basal third one large and usually a smaller tooth. This larva produced an adult, *Culex aberratus* n. sp., which resembles *C. impiger* very closely and may be separated therefrom by the posterior cross vein being its own length or more from the mid cross vein, the thorax spotless, basal abdominal bands distinct, and the petiole of the first submarginal cell one half the length of the cell.

A long-tubed larva with a comb consisting of about eighteen triangular, stout, spined scales arranged in two or more rows, some of the scales having a very stout, terminal spine with smaller ones along each side, while others have the tips somewhat rounded and the spines more nearly of a size, was taken in a woodland pool at Karner, on May 10, adults emerging on the sixteenth. The air tube is fully five times as long as its greatest diameter, tapering somewhat regularly and with a slight bend and contraction near the middle. There are two rows of pecten, each consisting of about twenty-two closely-set teeth bearing at their bases usually two larger and three or four fine serrations. This species, *Culex fitchii* n. sp., is close to *Culex squamiger* Coq., and may be separated therefrom by the scales of the pleura being white and the posterior cross vein its own length from the one above. The basal segments of the antennæ are clothed interiorly with broad white scales; proboscis dark-brown, long; palpi dark brown, segments narrowly ringed at the base with white; occiput clothed with brown scales, with a row of silvery ones just above the eyes and

* *Ent. Soc. Wash. Proc.*, **6**: 144, 1904.

along the median line. Thorax with a broad, brown, central stripe bordered with a rather well-defined silvery, slightly broader, lateral stripe containing a few brown blotches. Pleura rather thickly clothed with patches of silvery white scales.

These species will be characterized more fully in a Bulletin of the New York State Museum soon to be issued.

E. P. FELT,
D. B. YOUNG.

NOTES ON SOCIAL AND ECONOMIC SCIENCE.

AGRICULTURAL ECONOMICS.

INTEREST in agriculture, like that in commerce and industry, tends more and more to take upon itself an international character. The correlation of international experience and the comparison of experiments, tendencies and economic conditions is one of the most fruitful fields of research, not only to the economist, but equally so to the technical agriculturist and to the practical farmer. Consumers generally are interested to the extent to which prices are affected by the favorable or unfavorable harvests in any particular country or group of countries. Any country whose system of production or distribution remains too far behind in the progress of scientific and practical economics must sooner or later lose its capacity to compete in the world market. The same is true of any particular crop, unless it be favored by special natural advantages. Just at this time much attention is being given to the study of the comparative strength of nations and the leading national systems of productive efficiency. It is hoped, therefore, that the following more or less specific accounts of agricultural conditions in the several countries represented may be deemed of timely interest and value.

SCIENTIFIC AGRICULTURE IN JAPAN.

A RECENTLY returned writer from the far east calls attention to the fact which students of oriental civilizations have so long overlooked, namely, the extent to which the Japanese especially have accepted the truth that the natural sciences lie at the basis of the material development of nations. In its own way Japanese husbandry seems to have worked out much that the experiment station has accomplished in the west. This writer (Mr. Harold Bolce, in *Booklover's Magazine*) calls the Japanese, with their 19,000 square miles of arable land, the most remarkable agricultural nation the world has known. "If all the tillable acres of Japan were merged into one field," he says, "a man in an automobile, traveling at the rate of fifty miles an hour, could skirt the entire perimeter of arable Japan in eleven hours. Upon this narrow freehold Japan has reared a nation of imperial power, which is determined to enjoy commercial preeminence over the world of wealth and opportunity from Siberia to Siam, and already, by force of arms, is driving from the shores of Asia the greatest monarchy of Europe.

"The secret of the success of the little Daybreak Kingdom has been a mystery to many students of nations. Patriotism does not explain the riddle of its strength, neither can commerce, nor military equipment nor manufacturing skill. Western nations will fail fully to grasp the secret of the dynamic intensity of Japan to-day, and will dangerously underestimate the formidable possibilities of the Greater Japan (the Dai Nippon) of tomorrow, until they begin to study seriously the agricultural triumphs of that empire. For Japan, more scientifically than any other nation, past or present, has perfected the art of sending the roots of its civilization enduringly into the soil.

"Progressive experts of high authority throughout the orient now admit that in all the annals of agriculture there is nothing that ever approached the scientific skill of Sunrise husbandry. Patient diligence, with knowledge of the chemistry of soil and the physiology of plants, have yielded results that have astounded the most advanced agriculturists in western nations."

CHANGES IN BRITISH AGRICULTURAL POLICY.

THE progress of scientific agriculture in England increasingly takes the form of assistance in effecting the adaptation of the industry to such crops as do not compete with

foreign imports to such an extent as is the case with grain and provisions. British agriculture has always been slow to specialize, hence the time-honored rotation system has often persisted until returns disappeared. The resulting decline in values had most serious consequences, social, economic and political. It forced population into trade and industry, into cities and into the colonies, until the greatest drawback to successful agriculture is the scarcity of labor. This in turn has given rise to seasonal migrations of rural laborers to and from various sections of the British Isles. It has increased the burden of taxation on rural property, and with the decline of values and rural incomes, has materially lessened the revenue of the national treasury from this important source of public income. Finally, it has given rise to the most noteworthy political agitation since Cobden's time in the form of Mr. Joseph Chamberlain's campaign for the reorganization of the whole imperial fiscal system on a basis of preferential duties on trade between the mother country and the colonies, as against all other countries. Mr. Chamberlain has always regarded domestic agriculture as a neglected factor in British economic policy. His fiscal scheme has in view the restoration of this aspect of national enterprise, much as Germany and France do now, and also the development of colonial sources of food-stuff supplies, so as to decrease the degree of dependence on Russia, the United States and Argentina.

Below is a report on 'Decline in English Farm Values,' as transmitted by the United States Consul Mahin, of Nottingham, under date of July 12, 1904, relating primarily to Lincolnshire. While this locality has geographically a rather exceptional position on the east coast on account of its remoteness from large markets, it is nevertheless a representative rural county, and is in that respect typical of rural tendencies generally.

The excessive importation of food products from foreign countries, the report states, is charged with direct responsibility for a great decrease in the value of farm lands in this county. Recent investigations of values of agricultural land in Lincolnshire disclose an extraordinary decline; possibly, however, not typical of all England, for it is believed that in the county named the depression is particularly acute. It is stated that in some instances persons who a few years ago invested their all in land, and also mortgaged it to raise money to complete the payments, find now on attempting to sell that they can not get even the amounts advanced on the mortgages.

Many instances of remarkable decreases in value are given. In one case where a farm of 315 acres, which cost $74,000, was offered at auction the highest bid was $20,000. The owner of an estate which cost him nearly $300,000 is now vainly trying to sell it for just one half of that price. An estate of 628 acres, which sold in 1901 for $110,000, was in May of this year valued for probate at only $43,000. In comparison with years in the distant past the situation appears no better. A farm of 134 acres, purchased in 1881 for $30,000, sold for only $15,000 in 1901, and would probably bring even less to-day. Thirty-four acres, costing $8,000 in 1860, recently sold for $2,500. A tract of 103 acres brought over $30,000 in 1828, and a mortgage for $25,000 was placed on it; this year, in April, it sold for less than $14,000. But the severest phase is the decline in the values of small farms of from 30 to 100 acres, the property of persons who can least afford the loss they suffer. Many cases are given where sales were for one half and even one third the purchase price, and often the selling price failed to cover the mortgage given upon the property.

Rent rolls are also suffering. Instances are cited where they have decreased one half and more. In one case a renter of a farm increased his holdings by leasing an adjoining tract of the same size, and he now pays less rent for the two than formerly for the one farm. In these cases the chief sufferers are those who can best afford the loss.

The cases cited are all in Lincolnshire. The great depression there has caused the farmers to look about for other sources of revenue than those which are so disastrously affected by foreign imports, and just now many are turning to strawberries. Fields hitherto covered with small-grain crops are this year devoted to strawberries. The daily yield of the county is estimated at 250 long tons. Special trains are necessary to carry the berries to market—two or three a day, of 30 to 35 cars, each car holding nearly 1,000 six-pound baskets of the fruit.

Flowers are also being cultivated in Lincolnshire to a greater extent than ever before. Whole fields, in some cases extending as far as the eye can reach, are devoted entirely to flowers. They are packed in boxes, and it is said that the ship-

ment of 10 tons a day is not an unusual record at a single railway station.

Celery and carrots are also being grown in Lincolnshire to an extent never before thought of. The former yields $150 to $300 to the acre, while small grain yields only $40 to $50. But unfortunately, only a certain character of soil is favorable to celery culture, or the temptation would be to turn Lincolnshire into one vast celery bed. Much attention is also given to carrots in the attempt to retrieve losses due to the flood of imports. An acre will produce from 15 to 25 tons, at $10 a ton. The process of seeding is novel. The farmer mixes sand with his carrot seed, to prevent its being too thickly sown and thus being in large part wasted. A field, then, somewhat resembles a desert, across which the wind would whirl clouds of sand did not the farmer slightly ridge and then roll the field, checking the wind's effect.

Whether the experiment of substituting strawberries, celery and carrots for small grain, and in some cases for dairy products, will sensibly relieve the distress in Lincolnshire is a question which may not be answered for several years.

These developments raise the question whether agriculture in the eastern portion of the United States could not profit by Lincolnshire's experience. New England and the west are related much as Lincolnshire is to foreign competition. Specialization in non-competitive products has, with the progress of trucking in the south and of dairying in the west, possibly narrower limits than formerly. Nevertheless, the trucking seasons are not simultaneous, comparing the north with the south. Likewise there are lines of production in which the east may successfully compete with the west. Here is a line of inquiry on the subject of sectional farm policy in which much might be learned by collating the experience of other countries and studying in detail the local conditions, with a view to defining what might be called non-competitive spheres of production. Have the state and federal departments of agriculture given adequate attention to this phase of the subject?

THE AGRICULTURAL POLICY OF GERMANY.

The Contemporary Review has an exposition of the present trend of Germany's economic discussion in relation to agriculture, the history of which discussion the author, Edward Bernstein, traces from List's time (1789–1846) down to the present.* List was a German-American, it is well to recall, who was associated with the beginnings of the anthracite coal industry, afterwards was vice-consul of the United States in Germany and earlier (1817–1819) professor of political economy in Tübingen University. He died by his own hand in 1846. His great work, 'The National System of Political Economy,' was born, so to speak, out of his American experience, and was intended to put into scientific outline the policy which should guide the economic development of this country and Germany in their relations to Great Britain, then nearing the zenith of her industrial ascendency.

The commercial policy of the United States is now at the turning of the ways, and recurrence to List's famous theory of educational duties, *i. e.,* that protective duties must be confined to educating the manufacturing classes of the country up to the standard of their advanced competitors, is eminently timely. For Germany, List advocated an *agricultur-manufactur-Staat,* an economic system best represented by the home market idea. In List's time this meant duties on manufactured imports; now it means duties on agricultural products. Germany is becoming more and more a manufacturing country—*ein export industrie Staat.* The protection of agriculture, it is held by such professors as Wagner and Oldenburg, is necessary for broadening and deepening the domestic basis of the industrial structure, which would otherwise be dependent on the exigencies of the foreign market, with great danger to the state, especially in time of war.

The real motive for this policy in the economic thought of Germany lies deeper than the question of markets. The secret is sociological, and has its root in the fear that, with the urban growth of population, the decreased income value of landed estates and of agriculture generally, the landed nobility and with them the rural voter, must disappear from the social constitution of national society, leaving the control of the machinery of the state and

* 'German Professors and Protectionism,' *Contemporary Review,* July 1, 1904.

the execution of the mission of the empire, to the two warring camps of the capitalist class on the one hand and the social democracy on the other. The growth of industrial as against rural population means progress of these two powers. Hence higher duties on agricultural imports are required to maintain the balance of class power, capitalist, wage-class and agrarian. One may read here the effort of the privileged classes of German society to equalize more nearly these three economic classes as the three points which must determine the plane of well being of the privileged interests. The truth seems to be that Wagner's alarms are ill-founded. The landed gentry's estates, those of the 'gentleman farmer' who spends much of his time and substance away from his estates entrusted to second hands, comprise the weak spot in German agriculture. It is not protection so much as a deeper sense of economic responsibility, on the part of this class, that German agriculture needs. "The demonstration that the German peasantry can not exist with prices as they are is extremely specious. In some districts they may groan under hardships, but in others they do pretty well. . Growing towns and increasing industrial districts furnish splendid markets for them; it is in the mainly agricultural and not in the mainly industrial districts that the agricultural population decreases. The tide of immigration is strongest where the big estates for the landed gentry and semi-feudal nobility prevail."

John Franklin Crowell.

COOPERATION IN SOLAR RESEARCH.

At its last annual meeting, the National Academy of Sciences appointed a committee on solar research, consisting of George E. Hale, chairman, W. W. Campbell, S. P. Langley, A. A. Michelson and C. A. Young. At the invitation of this committee, various societies in Europe and the United States have appointed similar committees as follows:

England—Committee of the Royal Society: The president of the Royal Society (Sir William Huggins), the Astronomer Royal (Mr. W. H. M. Christie), Sir Norman Lockyer, Professor A. Schuster, Mr. H. F. Newall. *Committee of the Royal Astronomical Society:* The president of the Royal Astronomical Society (Professor H. H. Turner), with others to be appointed. Professor Turner, with others not yet named, will represent the two societies at the conference of delegates.

France—Committee of the Société Française de Physique: M. Henri Poincaré, M. Charles Fabry, M. A. Perot, and others not yet named. The views of the French spectroscopists on the question of standard wave-lengths are being ascertained by the committee, and MM. Fabry and Perot have been requested to prepare a memoir on the subject for presentation to the conference of delegates, where the society will be represented by M. Poincaré and others.

Germany—Committee of the Deutsche Physikalische Gesellschaft: Professor Ebert, Kayser, Kreusler, Lummer, Pringsheim, Runge, Straubel, Wilsing. The names of delegates have not yet been announced. Professor Kayser is preparing a memoir for the conference on the subject of standard wave-lengths.

Holland—Committee of the Royal Academy of Sciences, Amsterdam: Professors Kapteyn and Julius. Professor Kapteyn will represent the academy at the conference of delegates.

Italy—Committee of the Societa degli Spettroscopisti Italiani: Professor Tacchini, Professor Riccò, and others to be appointed. Professor Riccò will represent the society at the conference.

Russia—Director Backlund will probably attend the conference as the representative of Russia. Committees of the Russian societies will be appointed later.

United States—Committee of the National Academy of Sciences: Professor W. W. Campbell, George E. Hale, A. A. Michelson, S. P. Langley, C. A. Young. *Committee of the American Physical Society:* Professors J. S. Ames, Henry Crew, Percival Lewis, C. E. Mendenhall, E. F. Nichols. *Committee of the Astronomical and Astrophysical Society of America:* Professors E. B. Frost, C. G. Abbott, L. A. Bauer, C. D. Perrine, F. L. O. Wadsworth.

Other societies which were invited to appoint committees have not yet been heard from.

Conference of Delegates.—The conference of delegates will meet in St. Louis on Thursday, September 22, in conjunction with the International Congress of Arts and Science. Members of the committees who expect to attend the conference are requested to notify the undersigned.

The principal topics for discussion at the conference of delegates will probably include the following subjects: (1) Plans for cooperation in solar research, and the preparation of a general program of observations; (2) formation of an international committee to conduct this work; (3) adoption of a system of standard wave-lengths.

INVITATION TO THE INTERNATIONAL CONGRESS OF ARTS AND SCIENCE.

THE organizers of the congress, to be held at the universal exposition, St. Louis, on September 19–25, 1904, desire to invite the special attention of professors and men of science in the United States and Canada to the unexampled opportunity which it offers to meet and hear a great number of eminent men of learning. It is expected that more than three hundred eminent scholars of Europe and America will deliver discourses in the various departments and sections of the congress, and that several hundred shorter communications will be made by those present.

It is the desire of the directors of the fair and of all concerned in the organization that professors and instructors in our colleges and universities, and members of the learned professions generally, shall, so far as possible, do honor to our distinguished visitors by attending the congress. For this no fee is charged and no formality is necessary except enrolment on arrival. It is, however, desirable to apprise Mr. Howard J. Rogers, director of congresses, Universal Exposition, St. Louis, Mo., in advance, what departments of the congress one desires to attend. A program of its proceedings, with such other instructions as may be necessary, will be sent by Mr. Rogers on application.

NICHOLAS MURRAY BUTLER,
Chairman of the Administrative Board.
SIMON NEWCOMB,
Chairman of the Organizing Committee.

SCIENTIFIC NOTES AND NEWS.

THE nomination of Dr. George H. Darwin, Plumian professor of astronomy and experimental philosophy at Cambridge, as president of the British Association for the Advancement of Science was confirmed by the general committee at the Cambridge meeting, and he will preside at the meeting to be held next year at South Africa. Dr. John Perry, professor of mechanics and mathematics at the Royal College of Science, London, was elected treasurer in succession to Professor Carey Foster. The association will meet in York in 1906. It held its first and its fiftieth meeting at York, and two years hence will celebrate its seventy-fifth anniversary.

ON the occasion of the meeting of the British Association at Cambridge the university conferred its doctorate of science on the following men of science: Johan Oskar Backlund, director of the Central Nicolas Observatory at Poulkovo; Henri Becquerel, professor of physics in the École Polytechnique, Paris; Julius Wilhelm Brühl, professor of chemistry in the University of Heidelberg; Adolf Engler, professor of botany in the University of Berlin; Paul Heinrich von Groth, professor of mineralogy in the University of Munich; Albrecht Kossel, professor of physiology in the University of Heidelberg; Henry F. Osborn, professor of zoology in Columbia University, New York; Nikolaas Gerard Pierson, sometime Prime Minister of the Kingdom of the Netherlands; Vito Volterra, professor of applied mathematics in the University of Rome; Sir David Gill, F.R.S., his Majesty's astronomer at the Cape of Good Hope; Alfred William Howitt; Sir Norman Lockyer, F.R.S., director of the Solar Physics Observatory, South Kensington; Major Percy Alexander MacMahon, F.R.S., late Royal Artillery, formerly professor of physics, Ordnance College, Woolwich; Sir William Ramsay, F.R.S., professor of chemistry, University College, London; Arthur Schuster, F.R.S., professor of physics in the Victoria University of Manchester; Sir William Turner Thiselton-Dyer, F.R.S., director of the Royal Botanic Garden, Kew.

THE Seventh International Zoological Congress will meet in Boston in 1907 under the presidency of Mr. Alexander Agassiz.

Beloit College conferred at its recent commencement the degree of doctor of laws on Professor George E. Hale, director of the Yerkes Observatory, and on Professor Rollin D. Salisbury, head of the department of geography of the University of Chicago.

The gold medal of the American Geographical Society has been presented to Dr. Sven von Hedin by the United States Ambassador at Stockholm.

Dr. N. L. Britton, director of the N. Y. Botanical Garden, and Dr. J. N. Rose, of the U. S. National Museum, have taken up the study of the Cactaceæ. They propose to gather large living collections both at New York and Washington, much as they have done with the Crassulaceæ, and to continue their studies for a series of years, basing descriptions largely on living plants. Extensive field work will be done, especially in Mexico, and the earnest cooperation of botanists traveling in the southwest is solicited. The National Museum will gladly furnish means for sending material to Washington.

At the meeting of the board of regents of the University of California held on August 9, 1904, Professor C. A. Kofoid, of the department of zoology, was granted leave of absence from the university until March 15, 1905. Professor Kofoid will have charge of the plankton work of the Tropical Pacific cruise of the *Albatross*, to be conducted by Mr. Alexander Agassiz during the coming winter.

Mr. C. F. Austin, of the Maryland Agricultural College, has been appointed agriculturist at the central Cuban station.

Professor F. Kohlrausch has retired from the presidency of the German Reichsanstalt.

Professor W. Förster, who celebrated the fiftieth anniversary of his doctorate on August 5, will retire from the directorship of the Berlin Observatory on October 1.

Dr. Karl von Voit, of the Physiological Laboratory at Munich, celebrated, on August 8, the fiftieth anniversary of his doctorate.

Mr. S. A. McDowell, B.A., Trinity College, Cambridge, has been appointed assistant to the superintendent of the Museum of Zoology.

Dr. H. C. Müller, vice-director of the experiment station at Halle, has been appointed director of the chemical control station at the same place, to succeed the late Dr. L. Bühring.

Dr. K. Windisch, of Berlin, has been appointed director of the agricultural institute at Hohenheim.

Dr. Th. Loesner has been appointed curator in the botanical museum of Berlin University.

At a recent meeting of the state board of agriculture an appropriation was voted for a geological survey of the mineral resources of Virginia. The survey will be conducted jointly by the state board of agriculture and the Virginia Polytechnic Institute. Dr. Thomas L. Watson, professor of geology in the Polytechnic Institute, was appointed geologist-in-charge of the survey.

The museum of the University of Michigan has sent a party to the Porcupine Mountains and Isle Royale in Northern Michigan. The object of the trip is to make a preliminary ecological survey of the fauna and flora of the areas visited and to collect specimens for the museum. The field expenses of the party are met by the combined gifts of Mr. Bryant Walker, of Detroit, and the Hon. Peter White and Mr. N. M. Kaufmann, of Marquette. The party will spend about two months in the field.

We credited last week to the daily papers the statement that Professor Frederick Starr, professor of anthropology at the University of Chicago, would resign and would make an extended expedition to Japan and China. We are informed that this statement is entirely incorrect.

Dr. H. H. Turner, Savilian professor of astronomy in the University of Oxford, gave six illustrated lectures on astronomical discovery, and Professor Hugo de Vries, professor of botany at the University of Amsterdam, gave four lectures on the mutation theory at the University of Chicago during the present summer.

Stanford University publishes the bibliography of its staff in zoology, professors and students to 1903. In the list are 127 titles of papers by Professor Charles Henry Gilbert, 4 by Associate Professor George Clinton Price,

7 by Associate Professor Harold Heath, 19 by Assistant Professor John Otterbein Snyder, 21 by Curator Edwin Chapin Starks, 3 by James Francis Abbott, 3 by Frank Cramer, 9 by Walter Kenrick Fisher, 13 by Henry Weed Fowler, 1 by Arthur White Greeley, 28 by Joseph Grinnell, 1 by James Alexander Gunn, Jr., 2 by Flora Hartley (Mrs. C. W. Greene), 4 by Edmund Heller, 1 by James Franklin Illingworth, 1 by Richard Crittendon McGregor, 1 by Charles James Pierson, 4 by William Weightman Price, 4 by Cloudsley Rutter, 2 by Norman Bishop Scofield, 3 by Alvin Seale, 4 by Robert Evans Snodgrass, 2 by John M. Stowell and 4 by John Van Denburgh. The publications of President Jordan comprise 433 titles. The publications of Professor V. L. Kellogg, of the separate chair of entomology, are not included in this list.

THE centenary of the discovery of morphine by Adam Serteurner has recently been celebrated at Paderborn in Westphalia.

A STATUE of Sir Thomas Browne, by Mr. Henry Pegram, will be erected at Norwich.

MR. FRANK GUSTAVE RADELFINGER, assistant professor of mathematics in George Washington University and a practising patent attorney, known for his work on differential equations, died at Washington on August 15 at the age of thirty-four years.

THE Rev. Dr. Charles W. Shields, professor of the harmony of science and revealed religion at Princeton University since 1865, died at Newport on August 25, at the age of seventy-nine years.

PROFESSOR ANTONI DRASCHEQ, a member of the Austrian sanitary council, celebrated for his investigations in the disease of cholera, has died at Vienna.

THE death is also announced of Christof von Sigwart, professor of philosophy at Tübingen, and of the Rev. Dr. H. P. Gurney, principal of the Durham College of Science and professor of mathematics, who was killed by an Alpine accident on August 13.

As we have already announced, the Society of Chemical Industry will meet in New York, beginning on September 7. About one hundred foreign members are expected. The meeting will open with a reception at the Chemists' Club on Wednesday, and the regular sessions will begin at Columbia University on the following day. Elaborate arrangements have been made for the entertainment of the visitors, who will be taken by special train to the chief centers of chemical industry of the country and to the International Congress of Arts and Science at St. Louis.

THE Belgian Academy of Sciences offers a prize of 1,000 francs for the best research on the development of Amphioxus.

THERE is being held this month at Paris an International Exposition of Hygiene.

A CHEMICAL laboratory for the examination of imported food products will be opened in the Appraiser's Stores Building of the Treasury Department in New York by the Department of Agriculture on September 5. Five expert chemists will be engaged.

THE Antarctic relief ship, *Terra Nova,* has returned to England, and the first instalment of the specimens of the National Antarctic Expedition has arrived at the British Museum. The British Museum will undertake the classification, description and publication of the biological and geological collections.

ACCORDING to the *Consular Reports* the board of directors of the German Colonial Society has appropriated $7,140, to be paid in three yearly instalments, as an aid to the scientific experiment station which Dr. Hermann Meyer is soon to establish in the German colony of Neu-Würtemberg, Ria Grande do Sul, Brazil. This station is being organized for the purpose of making a large number of agricultural experiments. It is hoped that it will help the German colonists of the southern States of Brazil to secure better returns in the way of crops, which as yet, because of improper cultivation, have not been entirely satisfactory. About 250 acres, near the town of Elsenau, have been secured for the experiment station, and on this a number of houses will be erected, which will serve as workshops and dwellings for those engaged in conducting the experiments.

The New York *Times* states that the Interstate Park, for which the people of New York and New Jersey have had to fight so hard, is now an assured fact. It will extend fourteen miles along the west bank of the Hudson. This is the result of the agitation against the blasting away of the Palisades, which tower to the height of from 300 to 600 feet from Fort Lee to Piermont. Already the commission has expended $344,264 in laying out this park. In order to carry out the plans of the commission it will be necessary to acquire 175,000 acres, but there is a large sum still in the treasury, and the two states have agreed to bear an equal amount of the additional expense that will be necessary to make this park one of the most beautiful in the country. Work is just being begun on a boulevard that will extend the entire length of the park.

Our consul at Frankfort writes to the Department of Commerce that there are 220 agricultural cooperative associations in Russia. Some of them receive subsidies from the government or the district council. These associations purchase, at wholesale, agricultural implements and machinery, seeds, breeding stock, etc., which are sold on credit or on the instalment plan to the individual farmers. Agricultural exhibitions are held and lecturers are employed who go from place to place instructing the farmers in all branches of husbandry. Grounds are also set apart for experimenting by cultivating new plants. In many other ways the cooperative associations result beneficially for the Russian peasant.

UNIVERSITY AND EDUCATIONAL NEWS.

Wellesley College has received $10,000 and a collection of paintings by the will of A. W. Stetson, of Braintree.

Columbia University will celebrate the hundred and fiftieth anniversary of its foundation as King's College on the last four days of October. There will be a public reception on the afternoon of Friday, October 28, with all the university buildings open for inspection, and receptions within the larger reception, at which the offiers of the different departments will entertain. On Monday morning corner stones of four new buildings will be laid: the university chapel, the School of Mines building, Hartley Hall and a second university dormitory; and if the completion of the building is accomplished, the new Thompson physical education building of Teachers College will be dedicated. On Monday afternoon there will be the formal university convocation with a commemorative address by President Butler. There will also be lectures by foreign guests, but the details have not yet been announced.

According to the daily papers the treasurer of the Catholic University, Washington, has become financially embarrassed. It is said that he has invested $876,000 of the university's funds for it, paying the university 6 per cent. interest. He gave on July 25 a deed of trust for this amount to the university, but several banks have filed a petition in bankruptcy against him and seek to set aside the deed of trust as void.

Dr. Edmund J. James, president of Northwestern University, has been elected president of the University of Illinois, succeeding Dr. A. S. Draper, now superintendent of State Instruction in the State of New York.

Elias P. Lyon, assistant professor of physiology in the University of Chicago, has accepted the professorship of physiology in St. Louis University. Other members of the staff will be C. H. Neilson, associate professor of physiological chemistry and O. H. Brown, instructor in physiology, both coming from the physiological department of the University of Chicago.

Mr. Chancey Juday has been appointed instructor in zoology at the University of California.

Mr. Loye H. Miller has been appointed teacher of biology in the State Normal School at Los Angeles, California.

Dr. Robert E. Moritz, of the University of Nebraska, has been elected professor of mathematics in the University of Washington to succeed Professor Arthur Ranum who has resigned.

Dr. Böttger, docent for physical chemistry in the University of Leipzig, has been called to the Massachusetts Institute of Technology.